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# A COMPUTER PROGRAM FOR CALCULATING ALLOWABLE CUT USING THE AREA VOLUME CHECK METHOD

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In connection with a study of timber management planning on Pacific Northwest National Forests, a computer program has been written which calculates allowable cut by the area-volume check method, assuming volume regulation. This scheduling method is rather extensively used by public and private owners in the region to calculate allowable cut, especially for old-growth Douglas-fir forests in transition to young-growth forests.

## DESCRIPTION OF THE METHOD

The area-volume check method of calculating allowable cut consists of the following steps:[1]

1. Derive a first approximation of allowable annual cut, or trial cut. There are several ways to do this--the most common for old-growth Douglas-fir forests involves Hanzlik's formula.[2] Another way would be to use the annual cut for the previous year. In fact, an intelligent estimate may be adequate for this purpose.
2. Arrange data for the forest stands in order of cutting priority. In the Pacific Northwest, this has generally meant arranging stand data by decreasing age. In this manner, the oldest stands are scheduled to be cut first. Data include the total area and percentage of area which is thinnable by age class, rotation age, regeneration period, and factors which influence yields.

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[1] Western Forestry & Conservation Association. Reports of the West Coast Forestry Procedures Committee on various recommended forest practices and techniques. Rep. V. Determination of allowable cut for forests in the Douglas fir region, pp. 16-38. 1950.

[2] Davis, Kenneth P. American forest management. 482 pp., illus. New York, Toronto [etc.]: McGraw-Hill Book Co., Inc. 1954.

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3. Calculate the time required to cut each age class, using the first approximation of annual allowable cut. Knowing time required to cut each age class, and present average age of stands, calculate the average age of the stands when cut.

4. Calculate yield of stand when cut. Yield equations that are generally used specify "age when cut" as an independent variable.

5. Once all age classes are run through the above process, check to see if the cumulated years to cut the forest are equal to the rotation length or conversion period desired. Also, check the area cut per year for reasonableness.

6. If criteria regarding volume and area cut are not met, then change the trial cut in a systematic way and rerun the analysis. Continue this process until the desired conditions are met.

## DESCRIPTION OF THE *ARVOL* COMPUTER PROGRAM

*ARVOL* is a computer program for calculating allowable cut by the area-volume check method. The program is coded in *FORTRAN IV* for an IBM 7040 installation.

The program characteristics are:

1. A maximum of 40 age classes can be analyzed in this program. These age classes apply to the beginning of the rotation being analyzed. Any increment between age classes may be used, and the increment need not be constant between age classes.

2. Up to eight age classes predicted to have zero net growth (i.e., mortality equal to gross growth) are acceptable.

3. Two different equations may be used to calculate yields of stands under extensive management.

4. Either a separate yield equation for intensively managed stands may be entered, or a normal yield equation may be entered.

5. Both thinned and unthinned stands may be included in any one analysis.

6. A range of alternative rotation ages or conversion periods may be evaluated. A table is produced for each rotation alternative desired.

7. Regeneration period is entered as an input, and hence may be varied as desired by the user.

8. Precision of the final allowable cut may be set as desired by the user.

9. Problems may be stacked; i.e., a number of analyses may be completed in one computer run.

10. Minimum cutting age may be specified by the user.

11. Negative age classes may be assigned in those cases where a period longer than the assumed regeneration period is likely to occur.

*ARVOL* inputs:

1. Number of problems to be run.
2. Trial allowable cut.
3. Regeneration period.
4. Forward and backward increments to adjust allowable cut.
5. Age class identifiers which key to the yield equations.
6. An identifier which specifies which yield equations are to be used for intensively managed stands.
7. Beginning and ending rotation ages and intervening increment.
8. Minimum cutting age.
9. Area distribution by age class.
10. Percentage of area intensively managed by age class.
11. Yields of stands assumed to have zero net growth over the rotation or conversion period.
12. Coefficients of two empirical yield equations.
13. Coefficients of yield equation for intensively managed stands, or normal yield equation coefficients.

*ARVOL* outputs:

1. Area distribution by beginning age class.
2. Yield per acre when cut by beginning age class.
3. Total yield when cut by beginning age class.
4. Years required to cut the total yield by beginning age class.
5. Cumulated years required to cut the total yield by beginning age class.
6. Area to cut annually by beginning age class.
7. Average age when cut by beginning age class.
8. Total area.
9. Total volume.
10. Final allowable cut.
11. Rotation age.
12. Average area to cut each year over the conversion period.
13. Average yield per acre.
14. Average yield per acre per year.

## OPERATION OF THE *ARVOL* COMPUTER PROGRAM

The *ARVOL* program provides for printing only the final allowable cut and related data. The number of trial cuts required to arrive at the final cut is a function of two items: (1) accuracy of the starting approximation of allowable cut, which is a required input to the program, and (2) the level of precision desired by the user. The program begins at the level of cut set by the user as a first approximation and converges to final allowable cut by the forward and backward increments. If the first approximation is too low, the convergence will proceed forward, by the forward increment, until final cut is encountered or exceeded. If final cut is encountered, the final cut and associated outputs are printed, and the next rotation length or problem is considered. If the final cut is exceeded, the program proceeds to the final cut by the backward increment.

In view of the program behavior, as outlined above, it is easily seen that the precision desired in the allowable cut figure may be controlled by the levels of forward and backward increments set by the user.

The time requirements for a problem of any given size cannot be estimated with any certainty because speed of solution is dependent on the first approximation of allowable cut and the level of precision set by the user. Typical operating times are as follows:

| Number of age classes | Intensive management | Number of rotation lengths | Execution time (minutes)[1] |
|---|---|---|---|
| 25 | Yes | 23 | 4.73 |
| 24 | No | 23 | .72 |
| 26 | Yes | 13 | 3.95 |

[1] Does not include compilation time.

## AVAILABILITY OF *ARVOL*

Requests for the source program listing, *FORTRAN IV* source deck, and user's manual may be addressed to the Director, Pacific Northwest Forest and Range Experiment Station, U.S. Forest Service, P.O. Box 3141, Portland, Oregon 97208.